REMARKS/ARGUMENTS

Favorable reconsideration of this application is respectfully requested.

Initially, applicants note an Information Disclosure Statement (IDS) was filed in the present application on March 5, 2002. At this time acknowledgement of the references cited in that IDS has not been provided. Particularly, applicants request a returned initialed form PTO-1449 be provided to applicants acknowledging consideration of the cited references. For convenience a copy of the filed IDS, and its date-stamped filing receipt indicating its filing, is provided herewith.

Claims 11 and 16-22 are pending in this application. Claims 12 and 13 are canceled by the present response without prejudice and claim 22 is added by the present response. Claims 11, 13, 16, and 21 were rejected under 35 U.S.C. § 102(b) as anticipated by U.S. patent 5,387,555 to Linn et al. (herein "Linn"). Claims 12 and 17-20 were rejected under 35 U.S.C. § 103(a) as unpatentable over Linn in view of U.S. patent 5,877,070 to Goesele et al. (herein "Goesele").

Addressing the above-noted rejections, those rejections are traversed by the present response.

Applicants initially note the claims are amended by the present response to clarify features recited therein Specifically, independent claim 11 now clarifies that the second semiconductor element includes a "thin film" on the face bonded to the face of the first semiconductor element. That subject matter is fully supported by the original specification, see for example dependent claim 12.

The claims as currently written are believed to clearly distinguish over Linn, and further in view of Goesele.

Linn is directed to a method of creating an electrically conducting bonding between a face of a first semiconductor element and a face of a second semiconductor element by heat

treatment.[1] However, Linn does not disclose or suggest a method of creating an electrically conducting bonding between a face of a first semiconductor element and a face of a ***thin film*** included in a second semiconducting element by heat treatment, as now recited in independent claim 11.

In contrast to the claimed features, Linn only discloses a method of creating an electrical conducting bonding between two semiconductor elements made of thick or bulk silicon.[2] Thus, in Linn one of the two semiconductor elements being bonded does not include a ***thin film***.

Further, Linn discloses depositing at least one layer of material on a face of a first semiconductor element and at least one layer of material on a face of a second semiconductor element.[3] However, in Linn these layers made of electrical conductor material (platinum, cobalt, or tungsten) and of a semiconductor material (polysilicon) are not deposited directly on the two semiconductor elements; instead in Linn electrically insulating layers (oxide layers) 316, 406, 413, 516, 513 are interposed between these layers and the two semiconductor elements.

The applicants of the present invention recognized that certain bonding solutions result in the consumption of a part of a semiconductor film, which may be disadvantageous in the case of very thin films, and also result in the diffusion of a metal into a semiconductor, which can degrade its properties.[4]

Linn does not disclose or suggest a heat treatment not inducing any reaction product between deposited layers and at least one of the semiconductor elements when no insulating layers are provided between the deposited layers and the semiconductor elements. In contrast to Linn, in the claimed invention the deposited layers and the material of the semiconductor

[1]See Linn at column 1, lines 1-15.
[2] See Linn at column 3, lines 33-35, column 5, lines 35-37, and columns 6, lines 40-46.
[3] See Linn in Figures 3A, 5A, and column 3, lines 49-56.
[4] See, for example, the present specification at page 2, lines 20-26.

elements are chosen, and the reaction product is processed, to avoid the drawbacks noted above.

With respect to the claim feature of depositing one layer ***directly*** on the face of the first semiconductor element and at least one layer ***directly*** on the face of the thin film, the outstanding Office Action has taken the position that Linn discloses such features apparently because:

> Linn et al. teaches combining the layers to form a layer that provides electrically conducting bonding between the two faces...Linn anticipates the claims because the presence of the electrically insulating material does not [constitute] a teaching away. Linn et al. teaches combining the layers to form a layer that provides electrically conducting bonding between the semiconductor faces....[5]

That basis for the outstanding rejection is believed to not properly consider the claim features. Independent claim 11 is directed to a method that ***directly*** deposits one layer on the face of the first semiconductor element and one layer directly on the face of the thin film, at least one of those layers being an electrical conductor material. For Linn to meet the above-noted limitations Linn requires ***depositing*** at least one electrical conducting material ***directly*** on the face of the first semiconductor element or the face of a thin film. Linn simply does not teach or suggest such features as Linn discloses depositing insulating oxide layers directly on the face of the first semiconductor element and the face of the second semiconductor element. As noted above, in the claims an electrical conducting layer is ***directly*** deposited onto either the face of the first semiconductor element or the face of the thin film. Linn simply does not teach or suggest such a feature.

Further, with respect to independent claim 21, in addition to reciting the direct depositing of an electrical conducting material onto either face of the first semiconductor element or the face of the second semiconductor element, which features are believed to

[5] Office Action of September 21, 2004, page 5, prenumbered paragraph 8.

clearly distinguish over Linn as noted above, claim 21 additionally recites "wherein the thickness of the at least one oxide layer and the conductive layer with which the oxide reacts being such that the oxide formed is in a form of isolated precipitates that do not substantially harm the electrical conducting bonding". That feature is believed to further distinguish over the applied art.

In Linn the oxide layer 506 is the thinnest insulating layer separating the second semiconductor element 502 from the electrical bonding, and thereby this oxide layer 506 is of 0.05 μm (Linn at column 6, lines 48-49). As noted in the present specification at page 10, line 29 et seq., the at least one oxide layer has a thickness of only a few angstroms for not electrically insulating the second semiconductor element. Thereby, the oxide layer 506 in Linn cannot be considered thin enough for forming, after reaction, the isolated precipitates, as recited in claim 21.

Further, new independent claim 22 is presented for examination, which is similar to previously pending claim 13 rewritten in independent form, and which is also believed to distinguish over the applied art as Linn does not disclose any deposition of a layer with an "excess thickness" as recited therein.

Now turning to questions of obviousness of the claims, applicants note Linn teaches formation of a product by implementing the following steps:

(a) providing two semiconductor elements of bulk Si;

(b) depositing at least one insulating layer on at least the face of the second semiconductor element;

(c) depositing a layer of a semiconductor material (polysilicon) and a layer of electrical conductor material (platinum, cobalt, or tungsten) onto one or both semiconductor elements;

(d) applying the two semiconductor elements one against the other, with interposing of the layers of deposited material;

(e) carrying out a heat treatment wherein the deposited layers are reacting for forming a temperature stable mixture;

(f) reducing the second semiconductor element to only leave a final thin layer of Si onto the oxide layer formed at step (b).

The final structure obtained by Linn, see for example Figures 3c, 4c, 5c, is then a silicon-on-insulator (SOI) structure.[6] As a consequence, the thin layer (of Si) is finally not electrically connected to the electrical bonding layer and to the first semiconductor element (see for example Linn at column 6, lines 24-26), meaning that no current can be established between them.

In contrast to Linn, by practicing the method as set forth in claim 11, a final product is a thin layer electrically connected to the first semiconductor element through electrical bonding layer, as no insulating layer is present in the resulting product. Thus, the final product obtained differs from that in Linn.

Further, applicants respectfully submit one of ordinary skill in the art would not have been motivated to modify Linn to remove the oxide layers 316 in Figure 3a, 406 and 413 in Figure 4a, and 506 and 503 in Figure 5a to have a conductor link between the first semiconductor element and the second semiconductor element. More specifically, such a modification would not have been obvious because of problems of consumption of part of a second semiconductor element and diffusion of the metal element into it, as recognized by the present inventors, see for example the present specification at page 2, lines 19-26. Indeed, each oxide layer 316, 416, or 516 in Linn is provided to protect the second

[6] See for example Linn at column 2, lines 59-60.

semiconductor elements from such reactions, and the removal of such a layer would expose the semiconductor element to these problems.

Linn simply does not teach or suggest to one of ordinary skill in the art to carry out a heat treatment of the above-noted step (e) and to choose appropriate materials to avoid the above-noted problems, without providing the insulating layer beneath the second semiconductor element. Additionally, if Linn was modified such that the second semiconductor element included a thin film at its bonded face, as now clarified in amended independent claim 11, the above-noted problems become all the more important as the film is thin.

Moreover, no teachings in Goesele can overcome the above-noted deficiencies in Linn. Goesele teaches forming a thin film on a first element by:

(1) forming microcavities in the second semiconductor element by ionic implantation;[7]

(2) bonding the second semiconductor element to the first element;[8]

(3) heat treating for detaching the thin film from the second semiconductor element at the microcavities level.[9] The second semiconductor element is of Si, Ge, diamond, SiC, alloys of Si and Ge with C, or other materials.[10]

Thereby, the use of SiC in the bonding process was known from Goesele. However, if we consider that the above-noted step (2) of bonding is an anodic bonding, the first element being of glass or quartz, it is clear that the teachings of Goesele are very different from a technique of electrical conducting bonding such as disclosed in Linn and in the present invention.

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[7]See Goesele at column 6, lines 15-20; column 10, lines 13-30; and column 12, lines 6-11.
[8]See Goesele at column 4, lines 65-67; column 7, lines 59-65; and column 12, lines 13-16.
[9]See Goesele at column 5, lines 1-19; column 10, line 65 - column 11, line 7; and column 12, lines 16-18.
[10]See Goesele at column 3, lines 50-56.

Applicants respectfully submit one of ordinary skill in the art would not have applied the teachings of Goesele for solving problems of consumption of a part of a second semiconductor element and a diffusion of metal element into it during a heat treatment for an electrical conducting bonding, if no insulating layer protects the second semiconductor element, as Goesele is not directed to solving such problems or even recognizing such problems.

Moreover, applicants note there is no suggestion in any cited art as to how to perform an electrical conducting bonding between two semiconductor elements without a protection layer for the second semiconductor element, and without consuming a part of the second semiconductor element or diffusing metal into it. It is only the applicants of the present invention who recognized such problems and who solved such problems by the claimed invention.

Further, with respect to independent claim 21, neither Linn nor Goesele teach or suggest forming at least one oxide layer onto at least one of the deposited conductive layers between two semiconductor elements with a thickness allowing a reaction between the conductive layer and the deposited layer to form isolated precipitates that do not substantially harm the electrically conducting bonding.

Further, with respect to new independent claim 22, neither Linn nor Goesele teach or suggest any deposition of layers for forming an electrical conducting bonding between two semiconductor elements in which one of the layers is deposited with an excess thickness such that a part of that layer, in contact with another deposited layer, can bind with the other deposited layer to form a stable mixture, the other deposited layer with an excess thickness, in contact with the semiconductor element in which it is deposited, reacting during the heat treatment with the semiconductor element to form a film with ohmic contact.

In view of these foregoing comments, applicants respectfully submit each of independent claims 11, 21, and 22, and the claims dependent therefrom, patentably distinguish over the applied art.

As no other issues are pending in this application, it is respectfully submitted that the present application is now in condition for allowance, and it is hereby respectfully requested that this case be passed to issue.

Respectfully submitted,

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